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CATALOG NO. 103

PORTLAND SECTIONAL CONDUIT

A Complete
Underground Pipe Covering
System

H.W. JOHNS-MANVILLE Co.

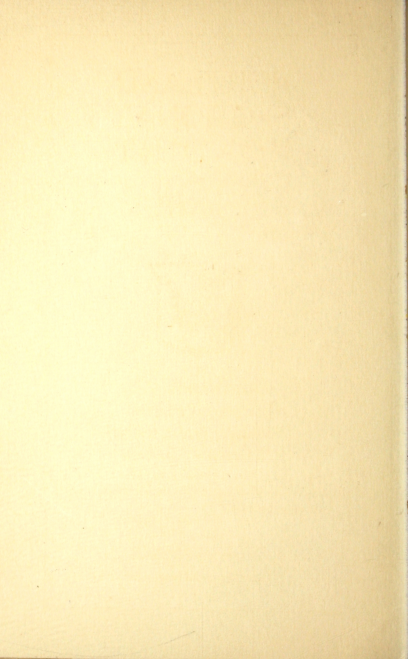
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PORTLAND SECTIONAL CONDUIT

FCR

PIPES CONVEYING STEAM,
WATER, GAS OR LIQUIDS



Catalog No. 103

The Only Perfect Protection
The Most Efficient Insulation
Complete In Every Detail

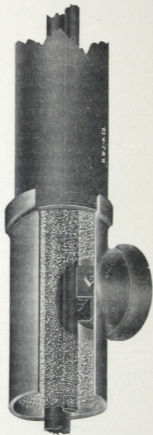
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Portland Sectional Conduit



A sectional view of Portland Conduit, showing the method by which pipes are supported and insulated underground.

Conduits

For Underground Piping



The need has long been recognized for a satisfactory method of protecting and insulating pipes carrying steam, water, brine, ammonia, and other gases or liquids for great or small distances underground. The desirability of doing this is apparent to the casual observer, and its feasibility is dependent only upon the possibility of obtaining proper protection and insulation, and obtaining these at a reasonable cost.

Many methods have been devised from time to time, but the description of the Portland Sectional Conduit presented in this catalogue, illustrates the method which has, beyond all question, proved to be the most satisfactory yet introduced; indeed, so near perfect is this method that little remains to be desired or effected.

The complete insulation obtained by the use of the Portland Sectional Conduit makes it possible to carry with economy either high or low pressure steam to any reasonable distance, without excessive cost for installation.

A careful consideration of the merits of this Sectional Conduit, and a comparison with other forms will convince the engineer or owner that the saving in cost of installation, the saving in the cost of maintenance, the increase in efficiency, the superior service, and the absolute protection and insulation secured, all prove the superiority of the Portland Sectional Conduit.

A system of underground conduits is of no advantage if it fails in the essentials of perfect insulation and protection to the pipes. If the conduit is not a perfect insulator, is not proof against moisture, acids, gases, fire, and the action of the earth, water, etc., its purpose is nullified, and it is therefore useless. Moreover, these qualities must be permanent.

Aside from Portland Sectional Conduit, nothing which entirely meets these conditions has been found. Its superiority over the old-fashioned pump log or its later successors, the laminated or segmental wood logs, or a wood box, however well built, need not be argued, as it is perfectly plain, and experience has demonstrated that conduits constructed of wood are not durable or waterproof, nor can they be made so for any length of time.

Another method commonly used is the small brick tunnel, the satisfactory condition and efficiency of which is short-lived. Under the best of circumstances it cannot be made water-tight, and therefore does not properly protect the pipes. There is also the method of building large tunnels of sufficient dimensions to permit the passage of men in addition to providing space for the pipes; but the cost of this is great, in most cases prohibitive, and its efficiency is less than that of the Sectional Conduit.

Makeshifts have been tried in the form of a conduit made by stringing common tile pipe on the pipes to be protected, or using the so-called "channel pipe," but these lack almost every important feature of the Portland Sectional Conduit, and are the least satisfactory of all the methods referred to above, as they have disadvantages not common to any of the other conduits mentioned. As conduits they are the least efficient and durable of all of the forms mentioned, this being principally due to the impossibility of making tight joints in the first place and in the second, the opening of the joints of the tile by the weight or movement of the pipes.

There is not a desirable feature in other systems which has not been carried to a state of perfection in Portland Sectional Conduit, while it embodies essential points not possessed by them, and this without increased cost of construction.

This Conduit is frequently applied to underground pipes which are already installed. This can be done with little or no disturbance of the piping, and is often made worth while by the increased efficiency and consequent saving made.

Portland Sectional Conduit

Portland Sectional Conduit is manufactured from a thoroughly ground and mixed combination of stoneware clay, fire-clay, and spar, being free from iron, lime, or other foreign substances injurious to the finished product.

The clays are selected, ground, and mixed under the direction and supervision of experts, insuring a proper uniform mixture throughout.

The method employed in drying Portland Conduit is modern, and extreme care is taken in this. The kilns are of the latest improved type, built expressly for the purpose of burning conduit and tile. The thousands of feet of Portland Conduit in use is unanswerable evidence of the perfection attained in its manufacture.

The mixture of clays used withstands perfectly the heat necessary for vitrification, as may be seen by an examination of Portland Conduit. For this reason the effect of the heat of steam may be disregarded.

The sections of Portland Conduit are thoroughly salt glazed, inside and out. The vitrifying and glazing is so thoroughly done that moisture cannot pass through, and yet the material between the glazed surfaces, containing innumerable air cells, is itself a good insulator.

Ample time is allowed in the cooling of the Conduit. The process is not hurried to the injury of the product, and as a consequence it is of the best quality.

The entire process of manufacture, drying, burning, vitrifying, glazing, and cooling, extends over a period of four weeks.



The durability and indestructibility of pottery ware has been established by the supreme test of time. The materials used in Portland Sectional Conduit are the same as those used in the famous Portland Sewer Pipe. There are many places where this pipe was installed thirty-four years or more ago and is still in use.

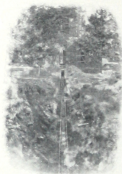
Pottery and other articles of burnt clay exhumed from the ruins of old Pompeii and Babylon stand to-day as evidence of the fact that pottery ware is as durable as the Pyramids.

Portland Sectional Conduit is formed in three-foot lengths, by hydraulic presses made expressly for this

purpose, and each length is brought to a sectional form by being divided longitudinally in two sections, these sections forming the top and bottom halves of the conduit. By means of knives inserted in the die which forms the Conduit, a cut from the inside halfway through the sides of the section is made longitudinally. After removal from the kilns the length is separated longitudinally on the lines of the cuts in a manner which leaves one-half or more of the thickness of the shell with a serrated edge without a glaze, and this surface will take cement

in such a way as to make a perfect joint, very much after the manner of mending a broken plate. The special method of this longitudinal cut has been adopted to make possible a water-tight joint.

Before being baked the top and bottom sections are numbered so as to prevent a later mismating, and to assure a perfect matching and jointing of the upper and lower halves. The importance of the proper matching of sections cannot be overstated, for in no other way can a satisfactory conduit be assured. Proper care in this, and in cementing will make a practically water-tight conduit.



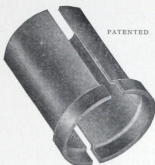
Parts and Pieces

An installation of the Portland Sectional Conduit is made up of the plain conduit sections, supporting tees with roll frames, observation tees, unions, piping, insulation, shutters, and necessary connections, with manholes or pits, etc., if required. The object of each part will be made plain in the following pages.

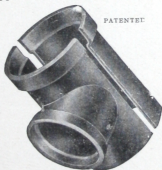
THE PLAIN SECTIONS of conduit form the greater part of any installation, their continuous use only being interrupted by the supporting tees, observation tees, and unions.

THE SUPPORTING TEE is one of the most important features of Portland Sectional Conduit. By reference to the cut illustrating this tee it will be seen that it is similar to the branch tee of sewer pipe. The supporting tee is so placed upon and so encloses a concrete base in which is placed the roll frame for pipe supports that it provides for the support of the pipes and their contents without permitting any of this weight to rest upon the Conduit, the movements of the pipes thus producing no effect on the Conduit. This method of support, when properly installed, is sufficient to bear any weight that may be put upon it, and is obtained without leaving or causing openings which may admit water.

THE OBSERVATION TEE is different in that the opening is placed on the top section of the Conduit and

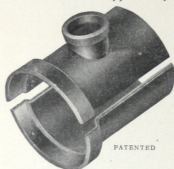


PLAIN SECTION



SUPPORTING TEE

is of eight inches inside diameter. Its purpose is to provide for the opportunity of a superficial inspection and



OBSERVATION TEE

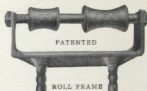
for refilling the Conduit where a granular form of insulation is used. It also serves to aid in locating a leak in the pipes enclosed should one occur, although where pipes are properly tested, as explained on page 26, this feature of the observation tee is seldom called into use. The observation tee should be so placed as to subdivide the run of Conduit into approximately one-hundred-foot sections

by placing one of these tees about one hundred feet from the end of the Conduit line, and then approximately one hundred feet apart. Thus no part of the pipes will be more than fifty feet from one of these observation points.

THE ROLL FRAMES, together with the supporting tees, provide for a practical and thorough support of the pipes. They are ordinarily made to provide for the support of from one to four pipes, but they can be made in order to provide for any combination of pipes that may be contained in the Conduit.

That most used is the two-roll frame illustrated below.

The roll frame is also made to carry additional pipes as shown on page 9.



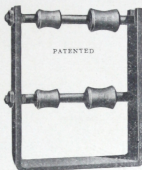
THE ROLLS used on these frames are specially made and adapted to Portland Conduit.

We recommend that the supporting tees and roll frames be placed fifteen or even eighteen, feet apart on centers where all pipes are six inches or larger in diameter, not more than fifteen feet apart on centers where there are pipes two inches to six inches in diameter, and twelve feet apart on centers where smaller pipes are in use. In start-

ing or ending a run of Conduit, place a supporting tee and roll frame close to the end of the run.

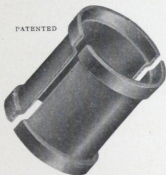
THE UNION consists of one length of Conduit with flange or bell on both ends. Its purpose is to bring to each end of a run of the Conduit a hub or bell end to facilitate the application of the shutter.

BENDS are seldom used and can only be used where there is at either end of the bend little or no lateral movement of the pipes enclosed. If the insulation takes the form of sectional pipe covering, a limited amount of lateral movement may



ROLL FRAME

PATENTED



UNION

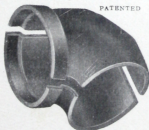
be provided for, but extreme care must be taken to see that under no circumstances one pipe touches another, or any pipe touches the Conduit at any point. Where the conduit filling is used, bends can be used only where there is no lateral movement of the pipes, as such movement would result in an injury to the Conduit.

THE EXPANSION of the pipes enclosed must be properly provided for. The meth-

ods of doing this are as many and as varied as are the conditions under which the Conduit is installed.

It may be done in a building at the end of the line of Conduit, in pits, or in manholes; by means of expansion joints, variators, swivel joints, swing joints, expansion arms, or in any way that circumstances may seem to dictate as best. The invariable rule remains here, as in other depart-

PATENTED



BEND

ments of piping, that the expansion must be properly provided for, and in such a way as to keep practically all of the movement of the pipe in a line parallel to the axis line of the conduit.*

THE INSULATION may, generally speaking, take any form usually applied to steam, water, ammonia, and brine pipes.



THE INSULATION FOR STEAM OR HOT WATER

The best method of insulation, and the cheapest, is to fill the entire space about the pipes within the Conduit with an indestructible non-conducting insulating material. The chief merit of this method lies in the fact that three or more inches of the best insulation are secured at the least expense, any movement of air over the pipes is absolutely prevented, and the air within the Conduit being subdivided into minute dead air-cells, increases the efficiency of the insulation. Such a filling is our ASBESTO-SPONGE CONDUIT FILLING, manufactured expressly for this purpose. Long experience has shown this to be the best insulator obtainable, and it is indestructible. It is in no way affected by heat, nor in case it becomes wet is it in any way injured. It is shipped in bags of approximately thirty pounds and weighs about seven pounds to the cubic foot as it should be filled into the Conduit. Other fillings of fibrous or granular natures have been tried, but are found to lack the essential characteristics of indestructibility by heat or water.

If the insulation is to be of the sectional form, it should be not less than two inches thick, and it may best consist of a material composed principally of a tough and indestructible fibre, such as our Asbestos-Sponge Felted Covering or our Asbestos Fire-Felt Sectional Covering, and where the sectional covering is used, we recommend that

instead of the usual canvas jacket there be applied a one-eighth-inch thickness of Standard Asbestos Roofing Jacket over the sectional covering, the whole to be thoroughly wired on with No. 18 copper wire.

Observation has shown that it is not wise to combine the sectional form of insulation with the filling, and that the filling far exceeds in efficiency any sectional covering.

It should be specially observed that the best covering is none too good and a cheaper insulation is more expensive in the end.

THE SHUTTERS at the ends of each run of Conduit serve the purpose of preventing the passage of vermin from one building to another, limit the amount of air movement over the pipes where the sectional covering is used, and serve to retain the filling within the Conduit where this method of insulation is used. They may be constructed of metal, but the simplest method is that shown, consisting of a cement surface three or four inches thick over a lattice work built in the bell end of the Conduit; or a brick facing may be built over the end of the Conduit, as shown in cut. (Page 18.)

In any case, the pipes as they pass through the shutter should be provided with a section of Asbesto-Sponge Felted pipe covering, six to twelve inches long, to serve as a collar through which the pipes may slide without injury. About this collar should be wrapped and wired a "J-M" Standard Asbestos Roofing Jacket to prevent the entrance of the cement into the covering. The cement shutters should be finished with a smooth surface of cement.

THE UNDERDRAIN, while no more essential to this form of Conduit than to any other successful conduit, is a most valuable adjunct. It serves to keep the water from about the Conduit, thus lessening the transmission of heat,



because dry earth will absorb or conduct heat with less readiness than wet earth or water. It also lessens the danger of a leakage of water into the Conduit. Its cost is but a few cents a foot, which is very small in proportion to the benefits derived.

The size of the underdrain to be used depends somewhat upon the extent of the Conduit system and the nature of the ground. In most cases a *drain five inches in diameter* is sufficient, and in a small system or at the beginning of the line a *four-inch drain* will do. In some cases where the system is extensive or where the ground contains an unusual amount of water, a drain six inches or larger in diameter may be required.

MANHOLES OR PITS are used only as required by the nature of the installation. In a small installation where only screwed joints are used, there seems to be no call for a large manhole, as the pipes may be anchored or a branch may be taken off in a small pit (familiarily called a blind pit) to which no ready means of access is provided. Wherever there may be valves, expansion joints, flanged joints, or other features which it may be desirable or necessary to get at occasionally or frequently, and which cannot be placed in a building into which the Conduit runs (which is the most desirable location) a manhole with a removable but water-tight cover should be employed. In small installations such pits and manholes are not, as a rule, required, and in large installations we recommend that they be avoided wherever possible, on account of the difficulty of waterproofing and cost of construction.

THE CEMENT used in this work should always be best quality, quick-setting American Portland Cement. Upon the quality of the cement, the thoroughness and care used in mixing, and the care used in applying will largely depend the durability and success of the Conduit construction.

Follow carefully the directions given on pages 27 and 28 for the use of the cement.

THE OPENING OF THIS CONDUIT at any time after its installation may be readily accomplished without injury to the Conduit, if carefully done, by using a long flat cold chisel along the line of the side joints.

The Conduit may again be put together and be perfect in every respect. We have known of several hundred feet of this Conduit having been taken up and relaid.

With the pipes to be enclosed properly tested, leaks are very rare occurrences, but this possibility of opening the Conduit provides for the repair of such leaks within this Conduit as well as it is provided for in any other form of Conduit. Some exception may be taken to this statement in favor of the large and expensive tunnel, but in the tunnel the leak can in the case of large pipes only be located, but not repaired without opening the tunnel at the top or sides to permit of the handling of pipes and wrenches on large pipes.



The locating of a possible leak in the Portland Sectional Conduit is made easy by a proper understanding of the use of the observation openings.

The Portland Sectional Conduit properly laid is as nearly waterproof as any masonry or sewer-pipe work can be made without special waterproofing felts or processes. Indeed, a great deal of this Conduit is in use in very wet places, and some of it is at times actually below the water level without serious leakage. To this end extreme care should be exercised in making all joints, especially the bottom of the bell joints. It is also recommended that each section of the Conduit be examined inside and outside at least twenty-four hours before it is to be laid, and that any fissures or cracks be filled and coated with a gruel of neat Portland Cement applied with a brush. After the cement on the joints has set (at least twenty-four hours being allowed for this purpose) it is recommended that a similar application of the cement gruel be made to the joints.

Laid as above, this Portland Sectional Conduit will prove less subject to water leakage than any other known

form of conduit; in fact, a practically water-tight conduit is assured under ordinary circumstances.

If the conditions are unusually severe as regards water, further steps in the nature of waterproofing may be undertaken which will occur to the engineer or contractor.

An inexpensive method of waterproofing which we give below will, if carefully applied to every portion of the exterior surface of the cement and tile (especially the bell joints at the bottom), render the Conduit thoroughly waterproof under all conditions.

This method is known as the "Sylvester Process" and has been used with success on concrete work by the Government engineers in connection with fortification work. The method of mixing and applying is as follows: Thoroughly dissolve $\frac{3}{4}$ pound of shaved Castile soap in 1 gallon of water, also dissolve $\frac{1}{2}$ pound of powdered alum in 4 gallons of water. The Conduit and cement surfaces should be dry and the soap wash applied first, at a boiling heat, being laid on with a flat brush and not allowed to froth. After the soap wash has been on about twenty-four hours and is thoroughly dry, the alum wash is applied in the same manner, at a temperature of about 65 degrees. This also should be allowed to dry for twenty-four hours before a second coat is put on. In a few cases one coat each of the two mixtures have been sufficient; generally two or three coats of each are necessary to make the concrete and cement impervious to water.



Report of Tests

The results given on this and the following page were obtained from actual tests made by Mr. Geo. H. Barrus, Expert and Consulting Engineer at the plant installed for Phillips and Abbot Academies at Andover, Mass.

In giving these figures obtained we would explain that the use of this line of mains makes possible the dispensing with two very large Cast-Iron Sectional Boilers at Abbot Academy and one Horizontal Tubular Boiler in the main building, two boilers that would have been required in the new McKeen Building, one boiler at Abbot Hall, and one boiler at Esther Memorial Building, which means that the operation of seven boilers is dispensed with, by the use of this underground line.

Moreover, this line of steam pipe is designed to heat more buildings at Abbot Academy in which still other boilers would be required.

Dimensions

Outside diameter of pipe	6.68 in.
" circumference of pipe	1.75 ft.
Length of pipe end to end	608. "
Area of pipe surface enclosed in Conduit	1,064 sq. "
Area of surface of elbows and connecting pipes at inlet and outlet covered with hair felt	6 " "
Total area of pipe radiating surface	1,070 " "

Data of Tests

	High Pressure	Low Pressure	
Date	Aug. 11.	Aug. 12.	1905.
Duration of test	5.	5.	Hrs.
Total weight of water drawn off	529.25	243.5	Lbs.
Weight of water drawn off per hour	105.85	48.7	"
Water drawn off per square foot of pipe surface per pipe	0.0989	0.0454	"
Moisture in the entering steam	0.3%	0.3%	
Steam condensed per square foot of surface per hour, corrected for moisture	0.0987	0.0451	"
Average pressure above atmosphere	83.	6.	"
Average temperature of steam corresponding to pressure	325.8	229.7	Deg.
Average temperature of water drawn off	306.4	222.6	"
Difference in temperature between steam within the pipe and assumed external temperature of 70 degrees	255.8	159.7	"

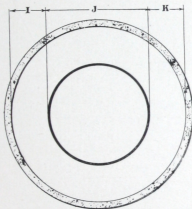
Results in British Thermal Units

	High Pressure	Low Pressure
Heat units corresponding to steam condensed per hour, reckoned from temperature of water drawn off, being the heat lost per hour by radiation	95,455.0	46,663.0
Heat units lost per degree difference of temperature within and without per square foot of pipe surface	0.349	0.273
Heat units lost by bare pipe per degree difference of temperature per square foot of surface per hour, based on previous experiments on pipes in still air	3.1	2.1
Efficiency of covering or percentage of loss by bare pipe saved by insulation	88.7	87.

To Determine Size of Conduit Required

The method of determining the size of Conduit to be used for different sizes of pipes is explained below with the aid of drawings and formulæ.

Where but one pipe is to be enclosed the internal diameter of the Conduit is found as follows:



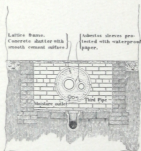
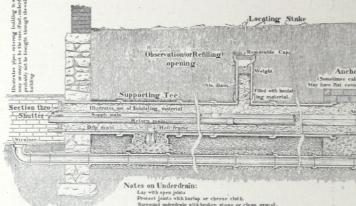
I and K = constant, 3 inches

J = external diam. of pipe

Find the sum of $I + J + K$ and take the size of Conduit next above this. For instance, if a 10" pipe is to be enclosed, I as always is 3", J is approximately $10\frac{1}{2}$ ", and K is always 3"; therefore, $I + J + K = 3" + 10\frac{1}{2}" + 3" = 16\frac{1}{2}"$, and the size of Conduit next above this is 18".

Cut Illustrating Details PORTLAND SE

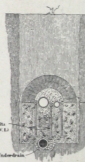
Illustrates pipe entering building in a pit which may or may not be the case if not indicated would probably not be brought through the wall into the building



ELEVATION OF SHUTTER



SECTION THROUGH
SUPPORTING TEE

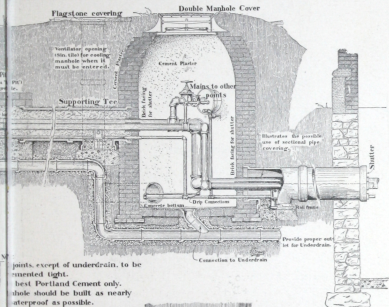


SECTION AT
ANCHOR POINT

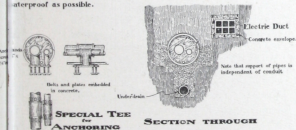
Two methods

C. H. Staten

Complete Installation of TUNNEL CONDUIT.



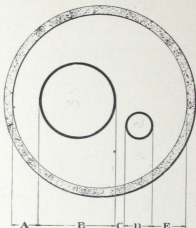
points, except of underdrain, to be cemented tight.
best Portland Cement only.
whole should be built as nearly waterproof as possible.



anchoring pipes illustrated.

**SECTION THROUGH
CONDUIT BETWEEN
SUPPORTS**

If two pipes are to be enclosed the size is determined as below.

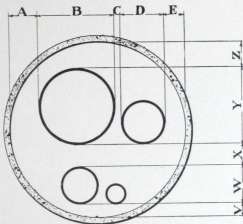


- A = constant, 3 inches
- B = external diam. of large pipe
- C = constant, 1 inch
- D = external diam. of small pipe
- E = constant, 3 inches

To illustrate: If the two pipes to be enclosed are 8" and 4" (commercial size), $A + B + C + D + E = 3" + 8\frac{1}{2}" + 1" + 4\frac{1}{2}" + 3" = 20"$, and the 20" Conduit would be used in this case.

If a third pipe, $1\frac{1}{2}"$ in diameter or smaller, were also to be enclosed, it might be placed below the other two pipes by means of the use of the drip-pipe roll, but in the case of a third pipe of larger size it would be placed on a level with the other pipe, adding to the diameter of the Conduit sufficiently to allow for this; or the four-roll frame might be better used when the size of the Conduit would be determined, as for four pipes as explained on next page.

When four pipes are to be enclosed in the conduit it is believed that the formula given below will be a satisfactory guide, in which it becomes necessary to consider the distance up and down as well as the distance across, and the greater distance only should be the guiding factor.



- $A = .4B$
 $B =$ ext. diam. of largest pipe on either level
 $C =$ constant, 1 inch
 $D =$ ext. diam. of other pipe on same level
 $E = .4D$
 $V = .5W$
 $W =$ ext. diam. largest pipe in lower row
 $X =$ constant, $3\frac{1}{2}$ inches
 $Y =$ external diam. largest pipe in upper row
 $Z = .5Y$
 $A, E,$ and Z must not be less than 3 inches
 V " " " " " $1\frac{1}{2}$ "

For illustration, assume the four pipes to be enclosed are 8" and 4" at the top, and $2\frac{1}{2}$ " and 2" at the bottom.

First, the distance across the top equals $A + B + C + D + E = 3\frac{1}{2}" + 8\frac{1}{2}" + 1" + 4\frac{1}{2}" + 3" = 20\frac{1}{4}"$, using convenient approximate fractions.

The distance up and down $= V + W + X + Y + Z = 1\frac{1}{2}" + 3" + 3\frac{1}{2}" + 8\frac{1}{2}" + 4\frac{1}{2}" = 20\frac{1}{4}"$.

The latter being in this case the greater, distance would alone be considered in selecting the size of the Conduit, and 22" being the next size would be the one selected.

A table of pipe dimensions is given on the last page of the catalogue, which will prove of assistance in giving the extreme dimensions of pipes and in determining the amount of insulating material required.

It is recommended that where more than two pipes are to be enclosed, the size be exactly determined by scale drawings, in the making of which the formula given will be of assistance.

Where more than four pipes are to be enclosed the size can only be determined by means of full size or scale drawings.

To determine the amount of insulating material required, consider each run of conduit separately. From the internal area of the conduit as given in the list, deduct the sum of the external areas of all of the pipes. Reduce the difference to square feet and multiply by the length of the run in feet, and the result will be the cubic feet of space to be filled. Multiply this by the weight of the insulating material per cubic foot, which in the case of the Asbesto-Sponge Insulating Material is approximately seven pounds, and the result will be the pounds of insulating material required for the run.



Directions for Installing Portland Sectional Conduit

Trenching

Having determined exactly the location of the line of Conduit to be laid as regards general direction and level, a trench should be dug to the desired depth, about twenty-four inches wider than the inside diameter of the Conduit to be used, and where possible this trench should be extended, as illustrated, to a sufficient depth to allow of the placing of an underdrain of the proper size under the Conduit.

The sides of the trench should be kept smooth and perpendicular to facilitate the work of constructing the Conduit. If necessary to keep the sides of the trench intact, bracing or sheet-piling should be employed.

The top of the Conduit should be below the frost line if possible, and the depth may vary from this to any desired depth. Portland Sectional Conduit has been laid over twenty feet below the surface of the ground where made necessary by the contour of the surface.



Underdrain

As stated elsewhere in this catalog we advise the use of an underdrain. This should be laid with open joints, the joints being protected by a single thickness of burlap or two thicknesses of cheese cloth to prevent the earth silting through, and entirely surrounding the underdrain should be placed clean coarse gravel or broken stone, which should be carried up to and around the bottom sections of the Conduit, the broken stone or gravel gradually growing finer towards the top.

All of the underdrain tile should be laid to a proper grade, and be arranged at its outlet to discharge into a drain or otherwise in such a way as to secure a permanent outlet.

Laying of Under Section of Conduit

To prepare the trench for the reception of the under section of the Conduit the gravel or broken stone should be brought up to and leveled off at the proper grade, with a thickness of not less than six inches under the Conduit, and then the laying of the lower section of the conduit should commence at one end of the line, the bottom sections being laid consecutively with the edges on the same level.

The corresponding top sections of the Conduit, which are determined by the corresponding numbers, should be laid beside the trench in corresponding order, so that no mistake may be made in putting the proper sections of the Conduit together.

At proper points, twelve to eighteen feet on centers as required, place the bottom of a supporting tee section, with its base thoroughly embedded in the concrete which supports the tee and roll frame, care being taken to see that the bottom of the section is level and firmly supported. It is advised that a supporting tee section be placed near any wall through which the Conduit is to pass.

The observation openings should be provided for by laying the bottom sections of the same at proper points as explained previously.

In laying the bottom section extreme care should be taken in the cementing of the end or hub joints, as this is the most important point in making a water-tight Conduit. Also see that no cement gets onto the edges of the Conduit to interfere with putting on the top half of the Conduit.

The cement for this and all other work in connection with the Conduit should be very carefully mixed in small quantities, so that it shall be freshly slacked when used. Do not use too much water, especially for the end joints, so that the cement may not run from the joints. See that the inside of the end joints are entirely filled with cement.

After the joint has been made as usual it should be carefully wiped over on the outside with the cement mortar.

Continue filling the gravel or broken stone up nearly to the level of the side joint of the conduit, tamping it thoroughly into place without disturbing the Conduit. The conduit should be thoroughly and firmly bedded and each section should be carefully centered to line and properly graded for pitch.

Roll Frames

The roll frames and rolls are specially designed for use with this Sectional Conduit.

After the supporting tee section of the Conduit is in place, as described above, set the roll frame in place, bracing the frame upon wedges or otherwise, so that it shall be firmly supported in exactly its proper place and level.

When the roll frame has been set in the proper position, fill the tee section with concrete to the level of the bottom of the Conduit, tamping the concrete firmly into place, and allow this to harden at least twelve hours before the pipes or any weight is placed upon the frame. These frames must be carefully set to the proper grade and line, and an inspection should be made to see that all rolls move easily on the rods.



Piping

The Conduit is now ready for the reception of pipes. In connection with the piping we would offer some suggestions, which are of importance.

We recommend that all pipes be painted a heavy coat of some graphite paint, such as Silica Graphite Black Paint, the paint being given sufficient time to dry and harden.

The pipes should be inspected to see that all threads are

perfect, and in handling the pipe and couplings care should be used to keep them clean and free from dirt. No crooked or irregular pipes should be used. Where the paint is removed by the use of the wrenches the pipes should be repainted.

The pipes should be carefully lowered into the trenches and placed upon the rolls. Care must be used in the selection of the lengths of pipe to see that no couplings on the different pipes come opposite each other, and that no coupling comes within 12" of any roll. We recommend the use of screwed joints in Portland Sectional Conduit, but flange joints may be used by allowing for the size of the same in selecting the size of the Conduit.

All pipes should be carefully tested, and, as steam pipes are the most frequently enclosed in such Conduit, we venture a suggestion as to the method of testing.

All pipes should be thoroughly blown out under steam pressure to free them from scale and dirt, as well as oil which may have collected during installation. When this is done a steam pressure of approximately fifteen pounds should be placed upon the pipes for not less than two hours, after which the pipes should be cooled and drained. When thoroughly cool they should again be placed under steam pressure to a pressure equal to at least fifty per cent more than will be required of them as a working pressure, in any case not less than fifty pounds pressure. Then the pipes should be allowed to cool, and when thoroughly cooled a hydraulic test should be made with the pressure carried to at least one hundred pounds, and in no case less than 50 per cent in excess of working pressure.

During each of the above tests the pipe and every joint should be carefully inspected for leakage, and every leak must be made tight, as not the slightest leak should be allowed to remain. No caulking should be permitted in repairing such leaks. The entire length of the pipe should be examined also, as frequently porous pipe is found.

During the testing of the pipes, as above, the expansion should be carefully noted to see that this is liberally provided for.

Incidental to the control of the expansion of the pipes is

the placing of the anchors which control this expansion. Suggestions for controlling this expansion are made elsewhere in this catalog.

Insulation

The insulation may now be applied according to the method adopted by the user of the Conduit.

If the sectional covering is used it may be applied in the usual way and at a less cost for application than in any other form of underground Conduits.

If the insulating filling is used, as mentioned elsewhere in this catalog, it should be put in place in connection with the placing of the top sections of the Conduit. The top sections are placed as explained below, and the entire remaining space about the pipes is filled with this filling, section by section, as the tops are applied.



Placing of Top Sections

In preparing for the placing of the top sections of the Conduit see that none of the cement used in making the end joints of the bottom sections has been allowed to fall or harden on the side joints, as this would interfere with the making of a proper side joint.

Clean and thoroughly wet the edges or side joints of both sections of the Conduit, and then apply a thin mortar of neat Portland Cement to the edges of the bottom section of Conduit to be covered, making sure that the upper or corresponding half of the sectional Conduit is the proper one. Use special care that the edges are placed exactly in the proper position, so that the joints become scarcely visible, and see that the top section sets firmly without any tendency to rock. Apply a coating of cement about one-quarter of an inch thick to the outside of these longi-

tudinal joints, filling any openings in the seam, and extending above and below the joint about two inches. With reasonable care this joint will become perfectly tight.

If the Conduit filling is to be used for insulation, place a weight upon this top section (a bag filled with sand is



suggested) to prevent any disturbance of this new joint and then fill the Conduit from the end with the insulating material. Make sure that the space below the pipe and above to the top of the Conduit is entirely filled and pressed sufficiently hard to prevent any settlement, but not hard enough to destroy the air-cells.

In laying these top sections it will be found convenient to omit the cementing of the end or hub joints of the top sections until after the laying of the tops, and filling with insulating material is otherwise completed, as this allows the air to escape before the insulating material as it is filled in, thus making easier the filling, and preventing any disturbance of this cement joint.

The top sections are put in place consecutively as above, and the insulating material is filled in as each top section is laid. When the top sections are all in place the end or hub joints of the tops may be firmly cemented after being thoroughly cleaned and wet.

All of these joints should be allowed to harden at least twelve hours before being covered with earth, and no heat should be allowed which would dry the cement too fast. In some cases it is necessary to protect these joints from the heat of the sun to prevent too rapid drying of the cement.

It is advised that all joints be left to dry for twelve hours, after which the joints and any cracks or rough places in the Conduit should be given a coat of neat Portland Cement gruel applied with a brush, which should be allowed to dry for four or more hours before being covered with earth.

If the above directions for cementing are carried out, a practically water-tight Conduit is secured.

Refilling of Trench

After the cement joints of the Conduit have been allowed time to harden as above, fill the trench at the sides of the Conduit with gravel or broken stone, as previously mentioned, to a height of six inches or more above the side joints, after which the trench may be refilled. It is advised that the earth be tamped in solidly, rather than puddled in with water.

Shutters

When the line of the Conduit has been completed as above, the ends of the Conduit should be filled with the insulating material, if this material is used, and a cement shutter on a wood frame should be built to prevent the loss of the insulating material or the passage of vermin in the Conduit.

This shutter is built by constructing a lath or wood frame in the hub of the Conduit upon which a cement mortar is plastered, this to be finished with a smooth cement surface. Sleeves consisting of a section of Asbestos-Sponge Felted Pipe Covering six to twelve inches long should first be placed around the pipe, these sleeves being covered with a jacket of "J-M" Standard Asbestos Roofing, to prevent the cement from getting into the covering. These asbestos sleeves provide for the protection and movement of the pipe.

In some cases the end of the tile may be so placed in the wall that the shutter may take the form of a brick facing built over the tile, fitting closely against its end, with the asbestos sleeves as above. Both forms of shutters are illustrated in the large drawing at the center of this book.

It is also advised that a short piece of pipe, 1" to 1½" in diameter, be placed in the bottom of these shutters to allow the exit of any moisture which may get into the Conduit.

A Few of our many Testimonials from parties who have used large quantities of this Sectional Conduit

PHILLIPS ACADEMY.

Treasurer's Office.

ANDOVER, MASS., March 28, 1905.

H. W. JOHNS-MANVILLE COMPANY, Boston, Mass.

Gentlemen:—Your letter of recent date is at hand requesting information on our experience of the Sectional Conduit, and in response we are pleased to state that we have used it in the heating plant for the Andover Theological Seminary and Phillips Academy, and we are very much pleased with the results.

We have found it economical to install and satisfactory in every way.

Yours very truly,

JAMES C. SAWYER, *Treasurer.*

MOUNT HOLYOKE COLLEGE.

Superintendent's Office.

SOUTH HADLEY, MASS., March 23, 1905.

H. W. JOHNS-MANVILLE COMPANY, Boston, Mass.

Gentlemen:—We are much pleased with the Portland Sectional Conduit, of which we have about 4,000 feet in use. We formerly made use of the brick tunnels as underground conduit for the steam pipes, and we find that the Sectional Conduit provides much better insulation and protects the steam pipes and is not more expensive to construct than other forms of underground conduit.

Very truly yours,

A. T. HILL, *Superintendent*

DARTMOUTH COLLEGE.

Department of Buildings and Grounds.

HANOVER, N. H., March 20, 1905.

H. W. JOHNS-MANVILLE COMPANY, Boston, Mass.

Gentlemen:—In reply to your letter of March 18th, regarding our experience with the Portland Sectional Conduit, I desire to say that we have had this material in use for several years under varying conditions, and we have found it very satisfactory.

We have had it in use in sizes from 10" to 24", approximately a mile in all, and believe that it has no superior in point of insulation and protection to the steam pipes, while in the matter of cost of installation we have found it to be less than the cost of brick trenches, or even wood conduits, to which, of course, it is much superior.

We are constantly adding to our system with this Sectional Conduit, which would indicate our entire satisfaction with it.

Yours very truly,

E. H. HUNTER, *Superintendent.*

CLEGHORN COMPANY.

BOSTON, MASS., March 22, 1905.

H. W. JOHNS-MANVILLE Company, Boston, Mass.

Gentlemen:—I am pleased to say that the Sectional Conduit has been very satisfactory wherever we have used it. I find no difficulty in installing it, and believe it to be the cheapest and best protection and insulation for steam pipes.

Very truly yours,

CLEGHORN COMPANY.

BRAMAN, DOW & CO.

BOSTON, MASS., March 22, 1905.

H. W. JOHNS-MANVILLE COMPANY, Boston, Mass.

Gentlemen:—Our experience with the Sectional Conduit has been entirely satisfactory. We have found no difficulty in installing it ourselves, as it is easier for our men to construct than any other form of conduit, and we believe it provides better insulation and protection to the pipes.

Yours very truly,

BRAMAN, DOW & CO.

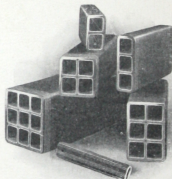
A Partial List of the Users of Portland Conduit

Dartmouth College	Hanover, N. H.
Braman, Dow & Co.	Boston, Mass.
Mt. Holyoke College	South Hadley, Mass.
Westboro Insane Hospital	Westboro, Mass.
Andover Theological Seminary	Andover, Mass.
Connecticut Hospital for Insane	Middletown, Conn.
Groton School	Groton, Mass.
Wellesley College	Wellesley, Mass.
Massachusetts Agricultural College	Amherst, Mass.
Phillips Academy	Andover, Mass.
New Hampshire College of Agriculture	Durham, N. H.
Williams College	Williamstown, Mass.
Northampton Insane Hospital	Northampton, Mass.
A. J. Givens, M.D.	Stamford, Conn.
G. M. Parks Company	Fitchburg, Mass.
Abbot Academy	Andover, Mass.
Cleghorn Company	Boston, Mass.
Berea College	Berea, Ky.
Washburn College	Topeka, Kan.
Wheaton Female Seminary	Norton, Mass.
Town of Andover	Andover Mass.
Wesleyan University	Middletown, Conn.
University of Rochester	Rochester, N. Y.
Wells College	Aurora, N. Y.
Danvers Insane Asylum	Danvers, Mass.
Holyoke Valve and Hydrant Company	Holyoke, Mass.

Norwich Hospital for Insane	Norwich, Conn.
Union College	Schenectady, N. Y.
N. Y. Central & H. R. R.R.	3 Installations.
Hotchkiss School	Lakeville, Conn.
Jewish Protectorate	Hawthorne, N. Y.
Federal Distilling Co.	Sparrows Point, Md.
Norfolk & New Brunswick Hosiery Co.	New Brunswick, N. J.
Edward B. Godfrey, Residence,	Oceanic, N. J.
American Brass Co.	Kenosha, Wis. .
Benedict & Burnham Co.	Waterbury, Conn.
Pacolet Cotton Mills	Pacolet, S. C.
Central R.R. of N. J.	Jersey City, N. J.
St. Paul's School	Concord, N. H.
Goulds Mfg. Co.	Seneca Falls, N. Y.
P. & F. Corbin Co.	New Britain, Conn.
Champion Coated Paper Co.	Canton, N. C.

Electric Conduit

It sometimes becomes desirable to install a system of underground electric conduits in connection with the sectional conduit. We are prepared to make estimates for the installation of an electric conduit system in conjunc-



tion with a system of Portland Conduit, or alone, or for furnishing the material for the same.

We use only the highest grade Conduit, fitted with dowels. This Conduit is so generally used as to need no detailed description.

Price List and Table of Information on Portland Sectional Conduit

Inside diameter of Conduit	6"	8"	10"	12"	15"	18"	20"	22"	24"	27"	30"
Conduit per ft., in 3-ft. lengths	\$0.36	\$0.60	\$0.90	\$1.20	\$1.62	\$2.04	\$2.70	\$3.30	\$3.90	\$7.14	\$9.25
*Supporting tee, each, 3 ft. long	1.62	2.70	4.08	7.80	14.22	17.86	23.64	28.89	34.14	53.56	69.30
*Observation " " 3 " "	1.62	2.70	4.08	7.80	10.56	13.26	17.56	21.46	25.36	35.70	46.20
Union, each, 3 " "		3.90	5.88	7.80	10.56	13.26	17.56	21.46	25.36	35.70	46.20
Bend, each, 18 in. from center in each direction	1.32	2.40	3.60	4.80	6.48	8.16	10.80	13.20	15.60	33.60	46.20
2-roll frame	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	7.00	7.50	8.00
4-roll frame	Not made in these sizes										
				7.50	8.00	8.50	9.75	13.00	15.00	16.00	17.00
Diameter (internal) of base of supporting tee		8"	10"	12"	15"	15"	18"	20"	20"	22"	24"
Distance center of Conduit to center of 5-in. underdrain		15"	17"	18"	20"	22"	24"	25"	27"	29"	31"
Weight of Conduit per ft. in lbs		22	32	46	65	85	100	120	136	230	290
Approx. weight of 2-roll frame	35	40	50	60	75	80	85	90	95	105	115
Gross int. area of Conduit in sq. inches	28.274	50.265	78.540	113.097	176.715	254.469	314.160	380.133	452.390	572.555	706.860
Thickness of shell of Conduit	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{5}{8}$ "	1"	1 $\frac{1}{8}$ "	1 $\frac{1}{2}$ "	1 $\frac{3}{4}$ "	1 $\frac{7}{8}$ "	1 $\frac{7}{8}$ "	2 $\frac{1}{8}$ "	2 $\frac{1}{2}$ "

Asbesto-Sponge Conduit Filling (approx. 7 lbs. per cu. ft.) in 30-lb. bags; \$320.00 list per ton.

*Except 6", 8" and 10", which are 2 ft. long.

Special net prices on application for electric conduit.

Special prices on application for tile pipe for underdrain or other purposes.

27" and 30" are made double thick.

All shipments are at the risk of the purchaser. No allowance for breakage.

The 4-roll frames with rolls approximate 50% heavier than the 2-roll frames.

Discounts on application.

Table of Dimensions of Standard Weight
Wrought-Iron Pipe

Inside Diameter.	Actual Outside Diameter.	Thickness.	Actual Inside Diameter.	Outside Circumference.	Length of Pipe Per Square Foot of Inside Surface.	Length of Pipe Per Square Foot of Outside Surface.	Inside Area.	Outside Area.	Weight Per Foot.
Ins.	Ins.	Ins.	Ins.	Ins.	Feet.	Feet.	Ins.	Ins.	Lbs.
$\frac{3}{8}$	0.405	0.068	0.270	1.272	14.15	9.44	0.0572	0.129	0.243
$\frac{1}{2}$	0.54	0.088	0.364	1.696	10.50	7.075	0.1041	0.229	0.422
$\frac{3}{4}$	0.675	0.091	0.494	2.121	7.67	5.657	0.1916	0.358	0.561
$\frac{7}{8}$	0.84	0.109	0.623	2.652	6.13	4.502	0.3048	0.554	0.845
1	1.05	0.113	0.824	3.299	4.635	3.637	0.5333	0.866	1.126
1 $\frac{1}{8}$	1.315	0.134	1.048	4.134	3.679	2.903	0.8627	1.357	1.670
1 $\frac{1}{4}$	1.66	0.140	1.380	5.215	2.768	2.301	1.496	2.164	2.258
1 $\frac{3}{8}$	1.90	0.145	1.611	5.969	2.371	2.01	2.038	2.835	2.694
2	2.375	0.154	2.067	7.461	1.848	1.611	3.355	4.430	3.600
2 $\frac{1}{2}$	2.875	0.204	2.468	9.032	1.547	1.328	4.783	6.491	5.773
3	3.50	0.217	3.067	10.996	1.245	1.091	7.388	9.621	7.547
3 $\frac{1}{2}$	4.00	0.226	3.548	12.566	1.077	0.955	9.878	12.566	9.055
4	4.50	0.237	4.026	14.137	0.949	0.849	12.307	15.904	10.66
4 $\frac{1}{2}$	5.00	0.247	4.508	15.708	0.848	0.765	15.939	19.635	12.34
5	5.563	0.259	5.045	17.475	0.757	0.629	19.990	24.299	14.50
6	6.625	0.280	6.065	20.813	0.63	0.577	28.889	34.471	18.767
7	7.625	0.301	7.023	23.954	0.544	0.595	38.737	45.663	23.27
8	8.625	0.322	7.982	27.096	0.478	0.444	50.039	58.426	28.177
9	9.625	0.344	9.001	30.433	0.425	0.394	63.633	73.715	33.70
10	10.75	0.3661	0.019	33.772	0.381	0.355	78.838	90.762	40.06
11	12.00	0.3751	1.25	37.699	0.340	0.318	98.942	113.097	45.95
12	12.75	0.3751	2.000	40.840	0.313	0.293	116.535	132.732	48.98
13	14.00	0.3751	3.25	43.982	0.290	0.273	134.582	153.938	53.92
14	15.00	0.3751	4.25	47.124	0.271	0.254	155.968	176.715	57.89
....	16.00	0.3751	5.25	50.265	0.254	0.238	177.867	201.062	61.77
....	18.00	0.3751	7.25	56.548	0.225	0.212	225.907	255.469	69.66
....	20.00	0.3751	9.25	62.832	0.202	0.191	279.720	314.160	77.57
....	22.00	0.3752	1.25	69.115	0.179	0.174	354.66	800.134	85.47
....	24.00	0.3752	3.25	75.39	0.164	0.159	424.56	452.39	93.37

List of "J-M" Catalogs

- Catalog 100.—"J-M" Asbestos and Magnesia Products.
- " 101.—"J-M" Asbestos Packings.
- " 102.—"Keystone" Hair Insulator.
- " 103.—Portland Sectional Conduit.
- " 104.—Cold-Storage Insulation.
- " 105.—Asbestos Household Specialties.
- " 106.—Manville Fire Extinguisher.
- " 107.—"Transite" Asbestos Fireproof Lumber.
- " 250.—"J-M" Railroad Supplies.
- " 302.—"J-M" Asbestos Roofing.
- " 400.—"Noark" National Electrical Code Standard Fuse Devices.
- " 401.—Complete "Noark" Fuse Catalog.
- " 402.—"J-M" Electrical Mine Supplies.
- " 14.—Electrical Supplies.
-

A copy of any of these catalogs will be mailed on request to our nearest branch.

"J-M"

Asbestos and Magnesia Products

Sectional Pipe Coverings.

Asbesto-Sponge Felted.

Asbestos Fire-Felt.

"J-M" 85% Magnesia.

"Asbestocel."

"J-M" Asbestos Moulded.

"J-M" Air Cell.

"Champion."

"Aqua."

"Zero."

Safety Blow-Off.

Portland Sectional Conduit.

Asbestos Papers, Sheets, Blocks and Cements.

Asbestos Yarn and Fabrics.

"J-M" Asbestos Roofing.

"Keystone" Hair Insulator.

Asbestos Building Materials.

Non-Burn Papers.

"Transite" Fireproof Lumber and Slate and
Corrugated Sheathing.

"J-M" Cork Insulation.

"J-M" Packings

For Steam, Air, Oil, Gas.

Asbestos Household Specialties.

Manville Fire Extinguisher.

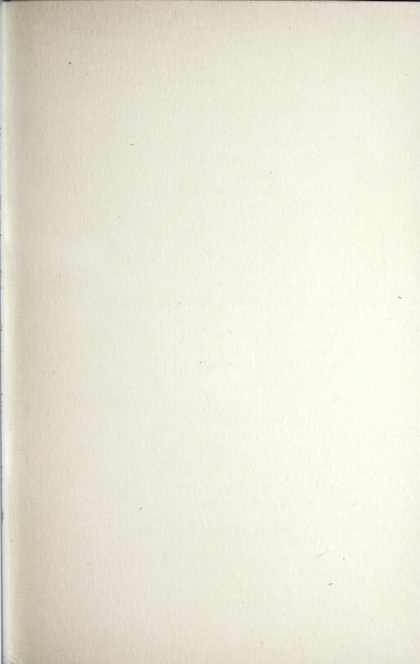
"J-M" Electrical Products

"Noark" Enclosed Fuse Devices.

"Vulcabeston" Insulation.

"Phoenix" Insulation.

Overhead Line Material.



H. W. JOHNS-MANVILLE CO.



"A Reputation behind it"